Department of Energy
Brookhaven Group
Building 464
P.O. Box 5000
Upton, New York 11973

OCT 27 1999

Anibal Taboas, Group Manager
Environmental Programs Group
Chicago Operations Office

SUBJECT: APPROVAL OF THE SAFETY EVALUATION REPORT (SER): BROOKHAVEN GRAPHITE RESEARCH REACTOR DECOMMISSIONING PROJECT (BGRR-DP)

Reference: Hazard Classification and Auditable Safety Analysis (ASA) for the Brookhaven Graphite Research Reactor (BGRR) Decommissioning Project, BGRR-002, Rev. 2, September 8, 1999

This letter requests your approval of the BGRR-DP SER (Enclosure 1). The basis for this approval is contained in the referenced ASA (Enclosure 2). The SER contains the technical evaluation for compliance with applicable requirements contained in DOE Orders and Standards. Your approval of the SER constitutes DOE's approval of the ASA and establishes the Safety Authorization Agreement between DOE and Brookhaven National Laboratory.

The ASA was reviewed by a DOE directed Safety Evaluation Review team, made up of subject matter experts from the DOE Brookhaven Group, the DOE Chicago Operations Office, and Horne Engineering. The SER team's comments and the resolution of those comments are provided in Review Comment Record (RCR) forms (Enclosure 3). These comments have been incorporated into the ASA and/or SER. Five Safety Evaluation Review Team members have concurred on the SER and two have non-concurred. The two members who have non-concurred raised two issues; 1) The Balance of Plant material-at-risk (MAR) is not zero as presented in the ASA and 2) The scenario that assumes 15% of the radionuclide inventory being released based on a postulated incredible single event accident is not defendable. Additional justifications and commitments were added to the SER to resolve the comments. In addition to the justifications and commitments, a BHG Senior Health Physics Specialist was requested to evaluate the calculations of the inventory to determine whether the basis for the dose modeling scenario was appropriate. His conclusion was the method used to determine the dose modeling scenario is substantiated. The justifications, commitments, and calculations are also found in enclosure 3.

The BGRR-DP is classified as "RADIOLOGICAL" on an interim basis, not to exceed one year from the date of approval of the ASA, at which time the ASA will be updated based on additional radiological characterization data. The work scope approved by this ASA is limited to surveillance,

routine maintenance and radiological/hazardous characterization.

Each phase of the decommissioning project will be preceded by additional characterization and hazards analysis after the work scope has been defined through a detailed Engineering Evaluation/Cost Analysis. The radiological inventory and hazards analysis will be screened using an approved Unresolved Safety Issue Determination (USID) process. Any hazards analysis or safety evaluations that are performed as a result of the USID process for work scope that is outside that approved by this ASA will be reviewed by the BGRR-DP Project Office and the DOE Brookhaven Group, and will be approved by the undersigned.

Please indicate your approval by signing the SER Concurrence and Approval Page and return the package to my office. Should you have additional questions or comments, you may contact Mr. James D. Goodenough on (516) 344-2423.

Sincerely,

George J. Malosh
Brookhaven Group Manager

Enclosures:
As stated

cc: M. Stahr, EM-441, GTN, w/encl. (Enclosure 1 only)
J. Roberts, EPG, CH, w/encl. (Enclosure 1 only)
J. Goodenough, EPG, CH, w/o encl.
E. Martinez, EPG, CH, w/o encl.
S. Mallette, BHG, w/encl. (Enclosure 1 only)
M. Dikeakos, BHG, w/encl. (Enclosure 1 only)
S. Pulsford, BNL, w/encl. (Enclosure 1 only)
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DOE SAFETY EVALUATION REPORT (SER)

BROOKHAVEN GRAPHITE RESEARCH REACTOR DECOMMISSIONING PROJECT

October 15, 1999

Concurrence and Approval Page

Concurrence:

James D. Goodenough, DOE-CH Team Leader — Date 10/15/99

Lloyd Nelson, DOE-BHG — Date 10/18/99

Maria V. Dikeakos, DOE-BHG — Date 10/20/99

Joe Drago, DOE-CH — Date

Robert I. Elder, DOE-CH — Date

James W. Dickey, Horne Engineering — Date

W. Lee Poe, Jr., Horne Engineering — Date

Compliance Review:

Lloyd Nelson, DOE-BHG — Date 10/18/99

Approval for Implementation:

George J. Malosh, Group Manager
DOE Brookhaven Group — Date 10/27/99

Anibal L. Taboas, Group Manager
Environmental Programs Group
DOE Chicago Operations Office — Date 11/18/99

DOE SER, BGRR-DP
Final Rev. 5

September 17, 1999

Concurrence and Approval Page

Concurrence:

James D. Goodenough, DOE-CH, Team Leader — Date

Lloyd Nelson, DOE-BHG — Date

Maria V. Dikeakos, DOE-BHG — Date

NON-CONCUR — 9/17/99
Joe Drago, DOE-CH — Date

Robert I. Elder, DOE-CH — Date

James W. Dickey, Horne Engineering — Date

W. Lee Poe, Jr., Horne Engineering — Date

Compliance Review:

Lloyd Nelson, DOE-BHG — Date

NOT REQUIRED — 9/17/99
Joe Drago, DOE-CH — Date

Approval for Implementation:

George J. Malosh, Group Manager
DOE Brookhaven Group — Date

Anibal L. Taboas, Group Manager
Environmental Programs Group
DOE Chicago Operations Office — Date

DOE SER, BGRR-DP
Final Rev. 5

September 17, 1999

Concurrence and Approval Page

Concurrence:

James D. Goodenough, DOE-CH, Team Leader — Date

Lloyd Nelson, DOE-BHG — Date

Maria V. Dikeakos, DOE-BHG — Date

Joe Drago, DOE-CH — Date

Non-Concur Robert I. Elder — 9/22/99
Robert I. Elder, DOE-CH — Date

James W. Dickey, Horne Engineering — Date

W. Lee Poe, Jr., Horne Engineering — Date

Compliance Review:

Lloyd Nelson, DOE-BHG — Date

Joe Drago, DOE-CH — Date

Approval for Implementation:

George J. Malosh, Group Manager
DOE Brookhaven Group — Date

Anibal L. Taboas, Group Manager
Environmental Programs Group
DOE Chicago Operations Office — Date

DOE SER, BGRR-DP
Final Rev. 4

September 13, 1999

Concurrence and Approval Page

Concurrence:

James D. Goodenough, DOE-CH, Team Leader — Date

Lloyd Nelson, DOE-BHG — Date

Maria V. Dikeakos, DOE-BHG — Date

Joe Drago, DOE-CH — Date

Robert I. Elder, DOE-CH — Date

James W. Dickey, Horne Engineering — Date 9/20/99

W. Lee Poe, Jr., Horne Engineering — Date

Compliance Review:

Lloyd Nelson, DOE-BHG — Date

Joe Drago, DOE-CH — Date

Approval for Implementation:

George J. Malosh, Group Manager
DOE Brookhaven Group — Date

Concurrence and Approval Page

Concurrence:

James D. Goodenough, DOE-CH, Team Leader — Date

Lloyd Nelson, DOE-BHG — Date

Maria V. Dikeakos, DOE-BHG — Date

Joe Drago, DOE-CH — Date

Robert I. Elder, DOE-CH — Date

James W. Dickey, Horne Engineering — Date

W. Lee Poe, Jr., Horne Engineering — Concur with comments see attached — 9/24/99 — Date

Compliance Review:

Lloyd Nelson, DOE-BHG — Date

Joe Drago, DOE-CH — Date

Approval for Implementation:

George J. Malosh, Group Manager
DOE Brookhaven Group — Date

Anibal L. Taboas, Group Manager
Environmental Programs Group
DOE Chicago Operations Office — Date

DOE SAFETY EVALUATION REPORT (SER)

BROOKHAVEN GRAPHITE RESEARCH REACTOR DECOMMISSIONING PROJECT (BGRR-DP)

EXECUTIVE SUMMARY

This Safety Evaluation Report (SER) documents the basis for the U.S. Department of Energy (DOE) Chicago Operations Office (CH) approval for Brookhaven Science Associates to execute the Brookhaven Graphite Research Reactor Decommissioning Project (BGRR-DP) described in the Project Management Plan (BGRR-01). The SER also documents the method of review and conclusions of the Safety Evaluation Review Team for the Hazard Classification and Auditable Safety Analysis (ASA) for the Brookhaven Graphite Research Reactor Decommissioning Project (BGRR-02).

The SER contains a summary of the ASA, which provides the approval authority sufficient knowledge and understanding of the basis for approving the ASA. It also 1) documents that an appropriate review of the ASA was conducted, 2) provides an independent assessment of the adequacy of the ASA, and 3) defines the conditions of DOE approval.

The SER was prepared to address the required content elements for the preparation of an SER in DOE-STD-1104-96, *Review and Approval of Nonreactor Nuclear Facility Safety Analysis Reports* [1]. The approach for determining the final hazard classification was derived from guidance in DOE-EM-STD-5502-94, *Hazard Baseline Documentation* [2]. All documentation related to the management of the SER Team is contained in Appendix A.

The objectives of the ASA are to identify the facility conditions and project scope, analyze accident and natural phenomena events for the activities authorized by the ASA, determine the facility hazard classification, and identify the safety management programs and controls necessary to protect the workers, the public and the environment for the BGRR Decommissioning Project (BGRR-DP).

A Safety Evaluation Review (SER) team composed of selected subject matter expert's [3] conducted an in depth review of the ASA. The SER team consisted of the DOE-BGRR Project Manager, three nuclear specialists, one facility representatives, and two operational, project management and decommissioning consultants. Each Safety Evaluation Review team member reviewed the entire document. The resolutions of team member comments have been incorporated into the ASA [4]. The Review Comment Record (RCR) resolutions are an integral element of the SER/ASA documentation [5].

The SER team concludes that the BGRR facility is classified as RADIOLOGICAL on an interim basis, and that the ASA and Safety Evaluation Report provide an adequate safety basis for the specific work scope identified in the ASA. This conclusion is based on the following premises:

1. The radiological material stored in the Nuclear Material Storage Vault is segmented from the radiological inventory associated with the BGRR facility because the Vault functions as a discrete sub-system that is isolated from the BGRR material at risk (MAR);

2. The form and distribution of the estimated Balance-of-Plant (BOP) radiological inventory is widely dispersed low-level contamination (WDLLC);

3. The form and distribution of the estimated Reactor Pile and Biological Shield radiological inventory is activated graphite and carbon steel. There is no evidence of any loose carbon dust within the void space of the Pile;

4. There are minimal quantities of hazardous material located within the BGRR facility;

5. The hazards analysis for the work scope authorized in the ASA does not yield any credible events that could result in hazard severity higher than "negligible" or risk category higher than "routine";

6. The BGRR radiological inventory is not releasable for airborne dispersion based on the hazards analysis and structural integrity of the confinement systems in place;

7. To establish a conservative final hazard classification of RADIOLOGICAL, a postulated accident scenario was analyzed that resulted in the release of 15% of the BOP radiological inventory to determine the Total Effective Dose Equivalent (TEDE) per Environmental Protection Agency guidelines. This analysis resulted in a TEDE of 4.5 Rem in 24-hours at 30-meters due to direct exposure, inhalation, and longer term ingestion exposure to the maximally exposed individual;

8. An adequate margin of safety can be maintained without relying on safety structures, systems and components for the work scope defined in the ASA;

9. Adequate administrative controls (in lieu of Technical Safety Requirements) have been developed using a graded approach to insure an acceptable operating envelope;

10. All controls and commitments defined in the ASA will be enforced, and;

11. Each BGRR-DP sub-project will be analyzed through an Unresolved Safety Issue Determination (USID) process, which will be supported by detailed characterization information; detailed engineering and work packages; radiological work procedures; and a task specific Health and Safety Plan.

1.0 INTRODUCTION

1.1 Purpose

The purpose of the Hazard Classification and Auditable Safety Analysis (ASA) for the BGRR-DP is to establish an acceptable operational safety envelope for the BGRR facility. The ASA defines the work scope or operations that will be associated with the project, analyzes the radiological material-at-risk, examines postulated accidents and hazards relating to the execution of the project, documents the final hazard classification (FHC), and identifies appropriate controls and commitments necessary to insure the protection of the workers, public and the environment. During the course of completing the planning and execution of the BGRR Project Baseline, the USID process may require additional safety and hazard analysis. The results of the USID process will be documented and become a part of the Authorization Basis Manual after review and approval by DOE.

The purpose of the Safety Evaluation Report is to document the results of an independent review of the Hazard Classification and Auditable Safety Analysis for the Brookhaven Graphite Research Reactor Decommissioning Project (BGRR-002) by a selected group of subject matter experts (SMEs). Each SME was selected based on their knowledge and experience with nuclear decommissioning operations, nuclear safety, occupational safety and health, hazardous materials operations, and radiological facility operations.

1.2 Review Process

This Safety Evaluation Report (SER) presents the results of the DOE-directed Safety Evaluation Review Team review and approval of the ASA Revision 2 dated September 8, 1999. The review was conducted by a Safety Evaluation Review Team composed of staff of the BGRR-DP Project Office, DOE-Brookhaven Group, DOE-Chicago and Horne Engineering. The SER was then reviewed for procedural compliance by staff from the DOE-Brookhaven Group Project Management Division [6].

1.3 Background and Operating History of the BGRR Facility

A summary of the BGRR background and operating history is included in the SER to aid the approval authority's review.

The BGRR was a graphite moderated and reflected, thermal neutron, air-cooled research reactor facility. The original fuel was natural uranium (NU) and the reactor achieved criticality on August 22, 1950. The fuel type was changed to highly enriched uranium (HEU) fuel elements in April of 1958. The final shutdown of the reactor occurred in

1969. The nominal power level of the reactor was 28 megawatts thermal (MWt) during the natural uranium fuel loading and 20 MWt during the enriched fuel loading.

The fuel elements were charged and discharged from the south face of the graphite pile by means of openings in the biological shield wall, which match the fuel channels in the graphite pile. The spent fuel was lowered into a chute or a cart which was then emptied into the chute extending from the floor of the south plenum to the bottom of the deep pit. The deep pit was part of the water-filled canals that served to shield, store, and prepare fuel elements and activated sources for shipment. The canal is 64 feet long and 8.5 feet deep, except for the 20-foot deep pit area near the reactor.

The other five faces of the reactor are penetrated by an assortment of experimental openings. The east and west faces also have eight penetrations each for control rods. Following permanent shutdown, the control rods were disconnected from the drives and inserted into the graphite pile. The biological shield penetrations for the control rods were covered with metal plates and tack-welded into place. The experimental openings were closed and/or plugged.

Radioactive equipment was removed from the experimental and underwater canal areas. The canal water was pumped down. The canal was cleaned with soap and water and covered with concrete slabs for shielding.

The BGRR has been in a safe-shutdown mode for the past 30-years (1969 – 1999). During this period, routine surveillance and maintenance activities have been conducted to insure that there has not been any spread of radioactive contamination.

The graphite moderator was regularly annealed during the years of operation and was again annealed in 1970 to remove any residual stored energy while all remaining fuel was shipped to the U.S. Department of Energy (DOE) Savannah River site during 1972. The BGRR complex was described as being in a safe shutdown condition by the U.S. Atomic Energy Commission (AEC) and became an "orphaned" facility within the DOE complex. From 1977 until 1997, portions of the facility were used as the Brookhaven National Laboratory (BNL) Science Museum.

The Removal Action Objectives for the BGRR-DP are to: protect human health and the environment; achieve future land-use objectives for the Brookhaven National Laboratory; remove or permanently isolate contaminants of potential concern; minimize the impacts of transporting and disposing large volumes of contaminated media; and meet all applicable or relevant and appropriate standards, requirements, criteria, or limitations promulgated under federal or state environmental laws.

1.4 Scope and Duration of the FHC and ASA Applicability

The Hazard Classification and Auditable Safety Analysis (ASA) will serve as the authorization basis for the BGRR Facility and sub-systems during the entire decommissioning project life cycle. USI determinations for each phase of the project scope will be added to the BGRR Authorization Basis Manual as they are developed and approved. The ASA will be modified or updated at the conclusion of the project for any post-closure groundwater monitoring or surveillance and maintenance, or will be cancelled.

2.0 HAZARDOUS SUBSTANCES INVENTORY AND HAZARD CLASSIFICATION

2.1 BGRR Balance of Plant (BOP) and Pile Inventory

The radiological inventory considered for the BGRR Facility hazard classification was based on two sources: 1) residual fission products and actinide daughters (BOP) calculated from burn-up code runs on unaccounted for NU fuel slugs, and 2) residual reactor pile activation (Pile) inventory based on conservative (maximum) operating power history and neutron flux levels. The sources for unaccounted fuel slugs included 1) in-reactor fuel element ruptures, and 2) reporting and recording errors.

The BOP inventory is estimated to total 1,530 Ci based on an estimated mass of remaining natural uranium fuel slugs of 14.62 Kg. This inventory includes Fe-55 which has very limited dose impact. Excluding the Fe-55 nuclide leaves an inventory of 130 Ci.

Activation product inventory was calculated assuming the BGRR was running 100% of the time at full power for the 18-year activation period. As the actual operating history included periods when the reactor was not operating at full power, these activity estimates are conservative. The pile graphite inventory is estimated at < 1,500 Ci. The radiological inventory represented by the control rods is < 200 Ci.

The SER Team has reviewed the analysis that supports the radiological MAR inventory and concludes that the form and distribution of the material is widely dispersed low-level contamination and activation of reactor pile and biological shield material, and that the inventory estimates are realistic.

2.2 Nuclear Material Storage Vault Inventory

The 701 Building Nuclear Material Storage Vault is a separate facility that has been analyzed by a separate Preliminary Hazard Analysis (PHA) and Basis for Interim Operations (BIO). The inventory of nuclear material is not considered in the material-at-risk inventory determination for the BGRR-DP project and is included in this ASA for reference.

2.3 Hazardous Material Inventory

The non-radiological hazardous materials inventory in the BGRR Facility includes the following:

- Asbestos and asbestos-containing material
- Mercury
- Lead shielding and lead-based paint
- Polychlorinated biphenyl (PCB)
- Cadmium

2.4 Hazard Classification Summary

A preliminary hazard classification (PHC) was developed to support the BGRR facility Basis for Interim Operation by summarizing the gross inventories of radioactive and hazardous chemicals present within the facility. These gross inventories were then compared to the threshold quantities (TQ's) in DOE-STD-1027-92 (DOE 1992b) and the reportable quantities (RQ) in 40 CFR 302.4 and 40 CFR68.130 to determine the PHC. The PHC for the BGRR facility was determined to be Nuclear Hazard Category 2. A supporting hazard analysis was subsequently prepared and provided the basis for the final hazard classification (FHC).

The SER Team concludes that the PHC was accurately determined based on the estimated radiological and hazardous materials inventories.

3.0 HAZARDS ANALYSIS

3.1 Preliminary Hazards Analysis (PHA)

A PHA was performed for the BGRR facility, which considered the entire BGRR facility, with the exception of the 701 Nuclear Material Storage Vault, in its current configuration. In performing the PHA, a Hazard Analysis Team identified hazards (postulated accidents and natural phenomena) and evaluated the possible causes and effects of potential scenarios involving these hazards. Consistent with the PHA approach, the team did not attempt to develop an exhaustive list of causes; rather, the team listed a sufficient number of causes to judge the credibility of the hazards. The hazard analysis team then evaluated the effects of each scenario. The effects identified by the team were limited to realistic but conservative impacts associated with the scenario. As a result, the team developed a credible list of scenarios for the BGRR facility. These scenarios are considered bounding based on the overall risk associated with the scenario.

3.2 Risk Assessment

The risk assessment of the BGRR is based on a methodical review of each of the initiating events and corresponding hazards associated with the facility, as originally defined by the PHA. Each initiating event and associated hazards were examined for severity, probability and risk category. Only one accident-initiating event is postulated to occur at any one time. All the PHA accident scenarios were listed and analyzed by a working group supporting the PHA consisting of independent reactor systems and ES&H subject matter experts. In subsequent reviews of related draft documents and earlier versions of this document, non-credible and/or non-hazardous events were eliminated, while those that were retained had post-mitigation parameter values added, as well as pre-mitigation parameter values refined as more and better information became available.

Table 3.1 presents a summary of the Risk Assessment for the BGRR. There are eight types of events addressed under the Risk Assessment for the BGRR during its current phase. They are: Seismic Event, High Winds, Graphite Dust Detonation, Loss of Pile Negative Pressure System Ventilation, Loss of Pile Negative Pressure System Filtration, Crane Load Drop, Fire, and Facility Worker Exposure to Toxic/Hazardous Material. The failure modes described by Table 3.1 represent the known or anticipated types of failure modes possible for the BGRR Facility as it currently exists. The specific examples cited represent the single-most severe combination of consequences and frequency deemed credible. Separate Risk Assessments have been completed in the ASA that represent an individual envelope encompassing a variety of similar or related events whose severity and probability fall within the bounds of the specific event analyzed. Each Risk Assessment Table event includes all lesser similar events with lower overall risk (a product of the functions of severity or consequence and probability or frequency). This combination of postulated events (caused by a variety of initiators) defines a bounding spectrum of accidents and natural phenomena with the capability of absorbing or subtending numerous specific but otherwise unnamed incidents under their overlapping umbrellas, so long as the specific event did not exceed the envelope for the type of event it represents.

Considering the administrative controls and other mitigating factors, only routine industrial risks exist for the non-intrusive work scope authorized by the ASA.

Table 3.1

RISK ASSESSMENT SUMMARY				
No.	System	Event	Risk Cat. Pre-mitigation	Risk Cat. Post-mitigation
001	BGRR Facility	0.15 g Seismic Event	4	4
002	BGRR Facility	High Winds	4	4
003	BGRR Facility	Graphite Dust Detonation	4	4
004	BGRR Facility	Loss of Pile Negative Pressure System Ventilation	4	4
005	BGRR Facility	Loss of Pile Negative Pressure System Filtration	4	4
006	BGRR Facility	Crane Load Drop	4	4
007	BGRR Facility	Fire	4	4
008	BGRR Facility	Facility Worker Exposure to Toxic/Hazardous Material	4	4
			4 = Routine	4 = Routine

3.3 Dose Assessment Summary

Based on engineering judgement[1], a hypothetical (though incredible) single accident was postulated that resulted in the release of 15% of the BOP radiological inventory. This inventory was further postulated to result in localized point source airborne release. A worst-case total effective dose equivalent (TEDE) to the maximally exposed individual, at 30-meters away from the release, over a 24-hour period due to direct exposure, inhalation, and longer term ingestion exposure was estimated at 4.5 Rem.

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[1] The following information supplements Section 3.2.2 of BGRR-002, page 3-8. Best engineering judgement was used to develop a dose consequence scenario of ~ 4.5 – 5.0 Rem as follows:

a) Assume the total BOP radiological inventory is estimate at ~ 300 – 340% of the Category 3 threshold.
b) Assume accident scenarios 001, 002, 006 or 007 could damage up to 25% of the entire BGRR Facility, at worst, in a single accident event.
c) Assume that up to 50% of the radiological material that is present anywhere within the facility is in the form of easily transferable material, while the rest (50%) is relatively well-fixed and not easily transferred (this is the general experience on other reactor decommissioning projects). This analysis provides a releasable inventory of ~ 37.5 – 45% of the Category 3 threshold (25% x 50% x 340% = 42.5%).
d) Assume worst case meteorological conditions for dispersion modeling discussed in DOE-STD-1027-92.
e) Using guidance in DOE-STD-1027-92, Attachment 1, and Environmental Protection Agency model (40 CFR 302.4) 100% of Category 3 Threshold Quantities represent a dose consequence of < 10 Rem, therefore, 42.5% of Catetory 3 Threshold Quantities represents a dose consequence of ~ 4.5 – 5.0 Rem (< 10 Rem).
f) A dose consequence of less than 10 Rem represents a facility hazard classification of less than Category 3, or RADIOLOGICAL.

This analysis will be added to the BGRR Hazard Classification and Auditable Safety Analysis (BGRR-002, Rev. 2, 9/8/99, during the next revision to the document.

3.4 Final Hazard Classification.

The SER Team concludes that BGRR facility final hazard classification is RADIOLOGICAL based on: a) the balance of plant (BOP) radiological material at risk (MAR) = 0%, b) the dose consequences of an unmitigated accident is less that 10 Rem (~ 4.5 Rem) at 30-meters over a 24-hour period to the maximally exposed individual, and c) applying the methodology described in DOE-EM-STD-5502-94, Figure 1 therein.

3.4.1 Material-At-Risk Analysis. Material-At-Risk is defined as: the amount of hazardous materials available to be acted on by a given physical stress. Based on credible hazard scenarios developed in the hazard analysis, the final hazard category may consider material form, location, dispersability, and interaction with available energy sources. These considerations can result in the reduction of the amount of material potentially subject to uncontrolled release, revise release fractions, and define different exposure pathways and time of exposure. Release scenarios may take credit for passive barrier systems provided that the barriers are not rendered ineffective by the scenario. The hazard analysis adequately considered an appropriate range of accidents and natural phenomena events. The BOP MAR form, location and dispersability has been determined to be widely dispersed low-level contamination. There are no credible scenarios that result in a release mechanism (energy source) that could result in rendering any of the passive barrier system in the BGRR facility ineffective by the scenario. Therefore, the radiological inventory material-at-risk is not releasable under any of the postulated hazard scenarios (MAR = 0%) and the facility can be classified as less than nuclear.

3.4.2 Dose Modeling Scenario. The methodology used in the Environmental Protection Agency document "Technical Background Document to Support Final Rulemaking Pursuant To Section 102 of the Comprehensive Environmental Response, Compensation, and Liability Act" (referenced in DOE-STD-1027-92) may be used to compute revised release values that corresponst to a 10-Rem dose at 30-meters.. A conservative (incredible) radiological release of 15% of the BOP inventory from a hypothetical single event accident was postulated to determine the hypothetical dose consequences. The postulated dose consequences were less than 10 Rem to the maximally exposed individual at a distance of 30-meters over a 24-hour period from all exposure pathways (Total Effective Dose Equivalent). When the dose consequences are determined to be less than 10 Rem, the facility may be classified as less than nuclear.

3.4.3 Table 1 of DOE-EM-STD-5502-94. An additional analysis was conducted to determine the appropriate Final Hazard Classification (See Table 3.2 Below).

Table 3.2. DOE-EM-STD-5502-94, Table 1 Analysis

Preliminary Hazard Classification – Nuclear Category 2. The "potential releasable radiation meets or exceeds DOE-STD-1027, Attachment 1 thresholds"	No	There is no material at risk of potential release based on the risk assessment of all postulated accidents and natural phenomena events presented in Section 3.3 of the ASA.
Potential Releasable Radiation RQ Meets of Exceeds 40CFR302, Appendix B Levels.	Yes	Assuming a maximal potential release of up to 15% of the BOP inventory defined under Section 2.3 of the ASA.
Potential Releasable Hazardous Material Below 29-CFR-1910.120 or 40-CFR-355 Thresholds	Yes	This is a conservative assumption. This analysis was not done because definitive inventory numbers were lacking. Assume the thresholds were exceeded.
Final Hazard Classification	Conservative Assumption	**RADIOLOGICAL**

3.5 SER Team Recommendation. The SER Team recommends the final hazard classification of the BGRR Facility as RADIOLOGICAL on an INTERIM basis until additional radiological characterization data is obtained and a detailed hazard classification is completed per DOE-STD-1027-91, Change 1.

4.0 CONTROL AND COMMITMENTS

4.1 Special Controls

BSA, through their work planning and control procedures, will strictly enforce the administrative controls identified in Sections 1.3 and 4.1 of the ASA. Administrative controls are an acceptable basis for maintaining an adequate margin of safety in lieu of the derivation of Technical Safety Requirements for a Radiological Facility.

4.2 Project-Specific Controls

The use of Safety Significant Structures, Systems and Components are not required to maintain an adequate safety envelope for the work scope defined and authorized by the ASA and are therefore not included as a commitment.

4.3 Programmatic Controls

BSA will enforce the programmatic controls identified in Section 4.3 of the ASA during the execution of the BGRR-DP. Any anticipated or implied waiver from any controls identified will require DOE approval.

4.4 Commitments

4.4.1 Interim Classification. DOE approves the BGRR facility as Radiological on an interim basis until such time as adequate characterization information is available to support a classification determination in accordance with DOE-STD-1027-92, Change 1. Characterization information will support a radiological inventory estimate of the following systems and/or subsystems: a) below-grade ducts and filter; b) fuel storage canal, canal house and water treatment system; c) reactor graphite pile, biological shield and associated experimental ports and systems.

4.4.2 Authorized Work Scope. Only that work scope identified by the ASA will be executed until, or unless, the activity identified as new work is specifically authorized through the USI review and approval process.

4.4.3 Special Controls. All special controls identified in the ASA will be adhered to.

4.4.4 Project-Specific Characterization. Any work scope that is determined to be outside the authority of the ASA will be preceded by a characterization activity to determine radiological and/or hazardous materials inventories and an USI screening will be completed in accordance with the approved procedure.

4.4.5 Unreviewed Safety Issue Determination Procedure. All work scope that is determined to be outside the authority of the ASA will be screened against an approved USI procedure [7]. A task-specific hazard analysis will be completed and reviewed as a part of the USI procedure for all work scope determined to be outside the authority of the ASA and must be approved by DOE before the work activities may begin. USIDs will be approved in accordance with DOE-BHG Administrative Instruction BHG-OA-17 [9]. Approval authority for USIDs will be delegated to the Group Manager, DOE Brookhaven Group.

4.4.6 Nuclear Material Storage Vault Inventory. The nuclear material in the 701 Building Nuclear Materials Storage Vault will be relocated to another accountable storage location prior to starting any decommissioning activities on the below grade exhaust ducts or the 701/702 Building. Characterization work in these areas will be permitted prior to removal of this material.

4.4.7 Water Intrusion Level Surveillance Monitoring. The water intrusion level surveillance monitoring system will remain operational until all below grade ducts and potential pathways for water intrusion have been adequately sealed [8].

4.5 BGRR Authorization Basis Manual. The following documents will constitute the BGRR Authorization Basis Manual and will be placed under configuration control: a) Hazard Classification and Auditable Safety Analysis (BGRR-002); b) Safety Evaluation Report and DOE Approval; c) BGRR Health and Safety Plan; d) BGRR Quality Assurance Project Plan; and, e) Unresolved Safety Issue Determinations with DOE Approval(s).

4.6 Future Revisions to the ASA. The BGRR Hazard Classification and Auditable Safety Analysis will be updated and revised at the conclusion of final facility characterization based on the results of the characterization data using DOE-STD-1027-92, Change 1, or at the end of Fiscal Year 2000, whichever is soonest. The final hazard categorization will be determined based on known or quantitative characterization information. Should the results of any sub-project characterization activity and/or USID determine that the facility categorization be changed or modified at any time, facility decommissioning safety programs will be re-evaluated to insure the protection of the workers, the public and the environment.

4.7 Records and References. Appendix A provides a reference to essential records, documentation and information generated throughout the review process and are available to the ASA approval authority on request. All USIDs that are subsequently developed will become an essential ASA control document subject to configuration management.

5.0 CONCLUSION

The Safety Evaluation Review (SER) Team concludes that the hazards associated with the work scope authorized by the ASA for Brookhaven Graphite Research Reactor Decommissioning Project have been adequately identified and evaluated. Further, the SER Team concludes that the BGRR Facility has been properly classified as RADIOLOGICAL on an interim basis pending additional characterization and analysis of radiological inventories. Adequate controls and commitments for the work scope activities identified in this ASA have been identified and will be enforced to protect the workers, the public or the environment. The SER Team recommends that the ASA be approved for execution.

Appendix A

Records and References:

1. Department of Energy, *Review and Approval of Nonreactor Nuclear Facility Safety Analysis Reports*, DOE-STD-1104-96.

2. Department of Energy, *Hazard Baseline Documentation*, DOE-EM-STD-5502-94.

3. Memorandum, J. Goodenough to Safety Evaluation Review Team, subject: Safety Evaluation Review dated May 13, 1999.

4. Memorandum, J. Goodenough to S. Pulsford, subject: DOE Review of the Hazard Classification and Auditable Safety Analysis (ASA) for the Brookhaven Graphite Research Reactor (BGRR) Decommissioning Project, dated May 26, 1999.

5. Letter, G. Malosh to M. Schlender, subject: Review of the Hazard Classification and Auditable Safety Analysis (ASA) for the Brookhaven Graphite Research Reactor (BGRR) Decommissioning Project, dated June 2, 1999.

6. Memorandum, J. Goodenough to Safety Evaluation Review Team, subject: Safety Evaluation Review Team Concurrence on the Hazard Classification and Auditable Safety Analysis for the Brookhaven Graphite Research Reactor Decommissioning Project, dated [July 2, 1999] *Stet.*

7. BGRR Procedure, BGRR-SOP-0902, Rev. 0, *Safety Evaluations for Unreviewed Safety Issue Determinations*, dated July 12, 1999.

8. BGRR Procedure, BGRR-SOP-0901, (Draft), *BGRR Monitoring and Surveillance Procedure.*

9. BHG Administrative Procedure, BHG-OA-17, *Review/Approval of Unresolved Safety Issue Determinations*, July 21, 1999.